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# A comparison study of geostatistical simulation for predicting soil texture


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## Introduction

Soil texture controls many important ecological, hydrological, and geomorphic processes. To predict the spatial distribution of soil texture, three-dimensional (3-D) geostatistical modeling is an important approach.

## Materials & methods

The study area is located near the Quzhou Experimental Station, China Agricultural University, Hebei Province (36° 51' N, 115° 3' E) in central North China Plain. Most of the area is flat, located in a loamy depression in the Zhang River's alluvial fan. Soils are saline to varying degrees and derived from recent alluvial deposits. These soils are typically composed of layers originally deposited under flood conditions.

In this study, sequential indicator simulation (**SIS**) and transition probability indicator simulation (**TPROGS**) were used for predicting soil texture in an area of the Zhang River's alluvial fan. A total of 139 soil profiles (Fig. 1) were sampled at intervals of 350 m from west to east, 300 m from north to south and 0.05 m in the vertical direction to a depth of 2 m covering 15 km$^2$ area.

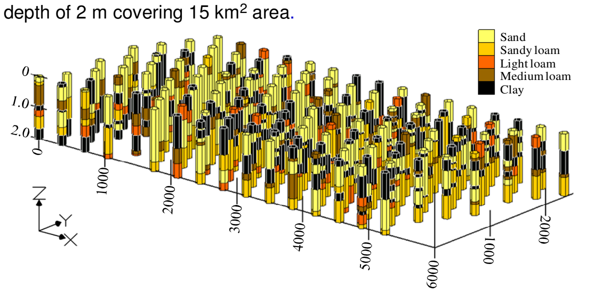


**Fig. 1. Three-Dimensional exhibition of measured soil profiles (Distance=m)**

## Results & discussions

Training results (Fig 2) showed that auto-variograms (**SIS**) fitted the observations well in the vertical direction, but poorly in the horizontal direction, while the auto-transition probability (**TPROGS**) fitted well in both directions.

## Results & discussions

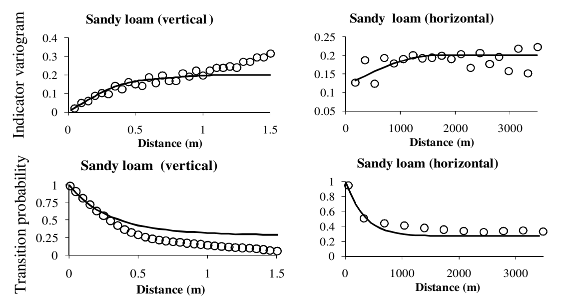


**Fig. 2. Auto-indicator variogram and auto-transition probability (circles) and their and corresponding fitted models (solid lines)**

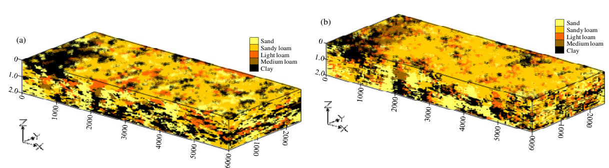

**Fig. 3. Three-Dimensional realizations (10) for SIS (a) and TPROGS (b) (Distance=m)**

Visually, predictions obtained from **SIS** and **TPROGS** are relatively consistent with the observed data (Fig. 3).

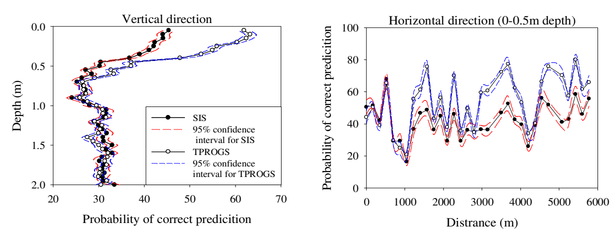


**Fig. 4. Probability of correct prediction in vertical and horizontal direction obtained from SIS and TPROGS modes**

## Results & discussions

The **TPROGS** model slightly improved (3.6%) overall predictions compared to **SIS**. Both **SIS** and **TPROGS** models predicted soil texture classes near soil surface (0-0.5 m) better than that in the deep depth (0.5-2.0 m) (Fig. 4). . However, the **TPROGS** model improved the prediction in the top soil indicating that the **TPROGS** can capture the variability of soil textures in vertical direction more efficiently than **SIS**.

## Conclusion

•The **TPROGS** model performed better than **SIS** for the near-surface (0-0.5 m) soils. It seems that under the circumstances of this study, **TPROGS** is a better model for predicting soil texture.

•Both models poorly predicted light loam and medium loam, probably because the portions of light loam and medium loam in this study are very low (<10%).

•Further improvement in modeling, however, is needed as only less than half of the total predictions were correct for the **TPROGS** model.

## Main referrences


Carle, S.F., Fogg, G.E., 1996. Transition probability-based indicator geostatistics. Mathematical Geology 28, 453–476.

Deutsch, C.V., Journel, A.G., 1998. GSLIB: Geostatistical Software Library and User's Guide.Oxford University Press, Oxford.

He, Y., Chen, D., Li., B.G., Huang, Y.F., Hu, K.L., Li, Y., Willett, I., 2009. Sequential indicator simulation and indicator kriging estimation of three dimensional soil textures. Australia Journal of soil research 47, 622–631.

Zhang, C.R., Li, W.D., 2008. Regional-scale modelling of the spatial distribution of surface and subsurface textural classes in alluvial soils using Markov chain geostatistics. Soil use and management 24, 263–272.


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